

# Land Use and Land Cover

## Background

Of all stressors to the environment, the conversion of undeveloped land may pose the highest ecological risk to New Jersey's environment and people. A recent study, which included input from a diverse group of experts, has found that physical alteration of habitat, a consequence of land use change, is one of the most compelling ecological problems in New Jersey. Statewide, habitat loss, fragmentation, and introduction of invasive exotic species are leading to species loss and permanent destruction within several of the state's ecosystems.<sup>1</sup> Negative effects of land use change also include traffic congestion, air pollution and increased flooding and stormwater flows due to greater impervious cover.

New Jersey has great ecological diversity, but its dense population makes accommodating the state's economic development and growth in population while protecting land, air and water resources and biodiversity a major challenge. Much of the state's ecological diversity depends on the maintenance of critical habitat. Especially important for many species are wetlands, which provide breeding grounds, nesting sites and other critical habitat for a variety of fish and wildlife species, and offer unique habitat for many threatened and endangered plants and animals.<sup>2</sup> Special wetland areas are vernal pools. Vernal pools are confined wetland depressions, either natural or man-made, that hold water for at least two consecutive months and are devoid of breeding fish populations. These ephemeral wetlands support a rich assembly of both reptiles and amphibians. Other important habitat types exist as well.

One sign of stress to the state's environment is the number of rare or endangered species that live in the state. More than 40 percent of the native vascular plant species in the state are considered rare, and approximately 15 percent of New Jersey's plant species are listed as endangered.<sup>3</sup> Like plant species, about one-third of the known vertebrate animal species in New Jersey are classified as either rare or endangered.<sup>4</sup>

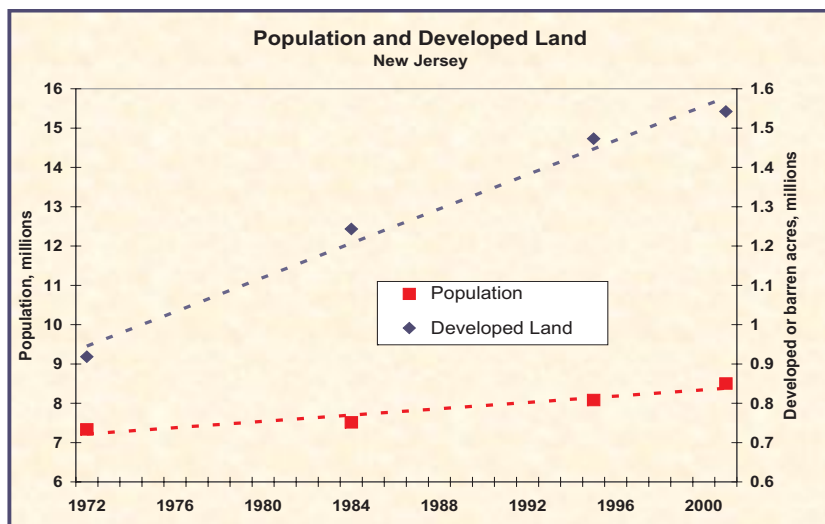
In the last few years, advancements have been made in the ability to use aerial photography<sup>5</sup> and information sensed by satellites<sup>6</sup> to detect changes in land use and land cover. On-the-ground surveys and analyses continue to yield valuable information as well.<sup>7</sup>

## Status and Trends

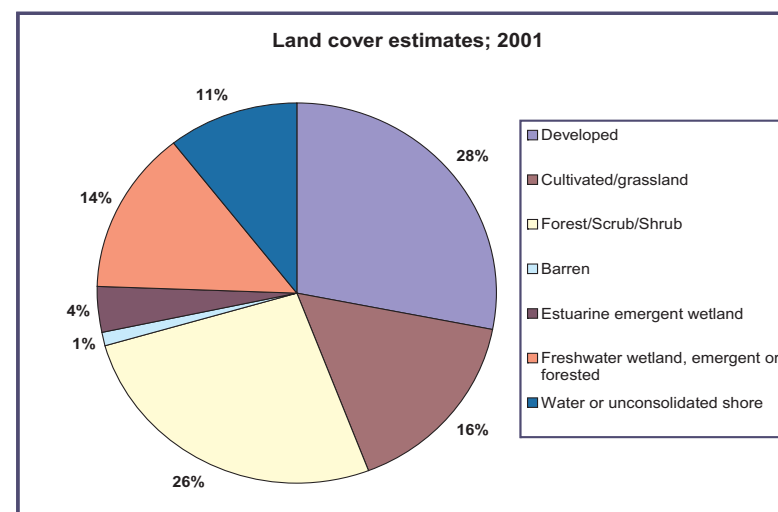
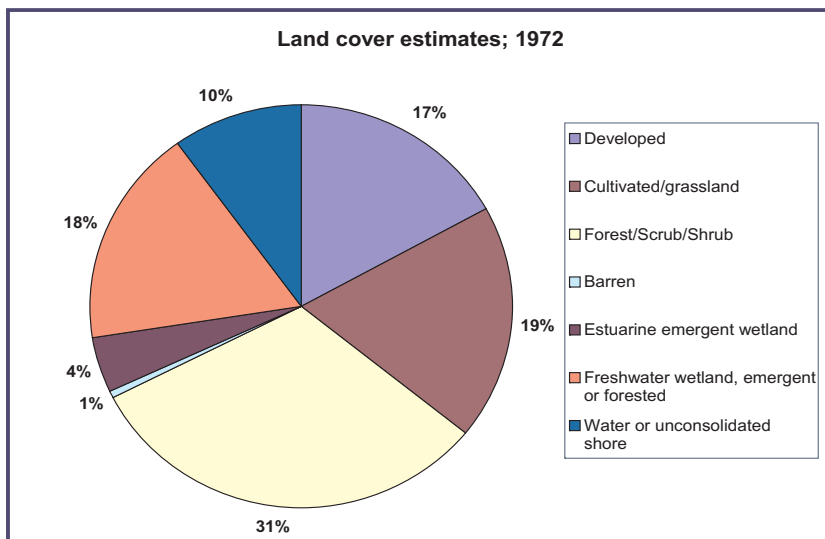
Changes in the type of land cover and land use are now monitored as new aerial photography and satellite data become available. For example, a change from undeveloped land, such as forest or meadow, to developed land, such as houses, can readily be observed. Other changes, such as in type or size of trees in a forest, are more subtle and must rely on on-the-ground surveys.

An important parameter of land use and land cover is the amount of developed land in the state. Developed land includes both land with houses and other buildings and paved or other areas that are essentially impervious to infiltration of rainfall. It also includes barren land, or land that has been denuded of vegetation or other cover, usually as part of construction activities. The amount of developed land in New Jersey, compared with population growth in the same period, is shown in the chart "Population and Developed Land: New Jersey" below. This chart is a graphical representation of sprawl – a pattern of development that consumes relatively large amounts of land as population growth increases.

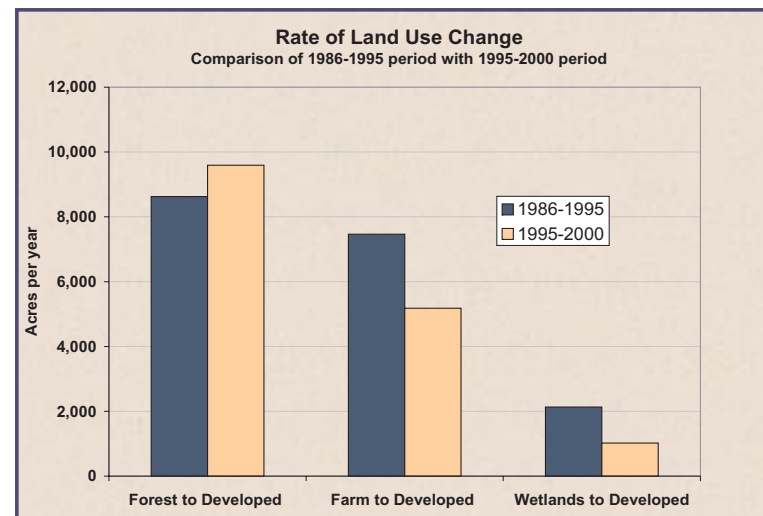
As shown in this chart, during the 29-year period from 1972 to 2001 over 600,000 acres of land has been developed in New Jersey. This represents an increase of about 68% in the amount of developed land in the state. During the same period population grew by only about 16%. Although the overall rate at which land has been developed slowed somewhat in the late 90s, over the 29-year period land has been developed in New Jersey at a rate of more than 58 acres per day.



Changes in the state's type of land use from 1972 to 2001 are shown in the charts "Land cover estimates: 1972" and "Land cover estimates: 2001" below. These data reflect what can be observed from satellite imagery.



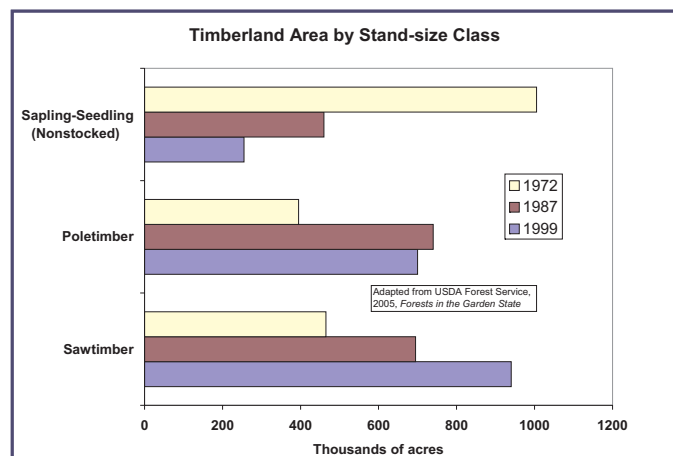
A comparison of the annual rate of three types of land use change is shown in the chart "Rate of Land Use Change" below. These data, based on satellite and aerial photography data, show that the rate of loss of wetlands and farmlands to development appears to have slowed recently, while the rate of loss of forest not only has not slowed, it may have increased.



A more detailed look at some of the general types of land classifications noted above reveals additional potentially important features and trends.

## Forests

As noted above, the USDA Forest Service, in cooperation with the DEP, conducts periodic inventories of the state's forests. The most recent inventory, completed in 1999, revealed significant details about the state's forests that



are not observable via satellite or aerial photos alone.<sup>8</sup>

For example, the average size of trees in New Jersey's forests is changing. Forest stand structures today are typically more mature and contain larger trees than the have in the past. The chart

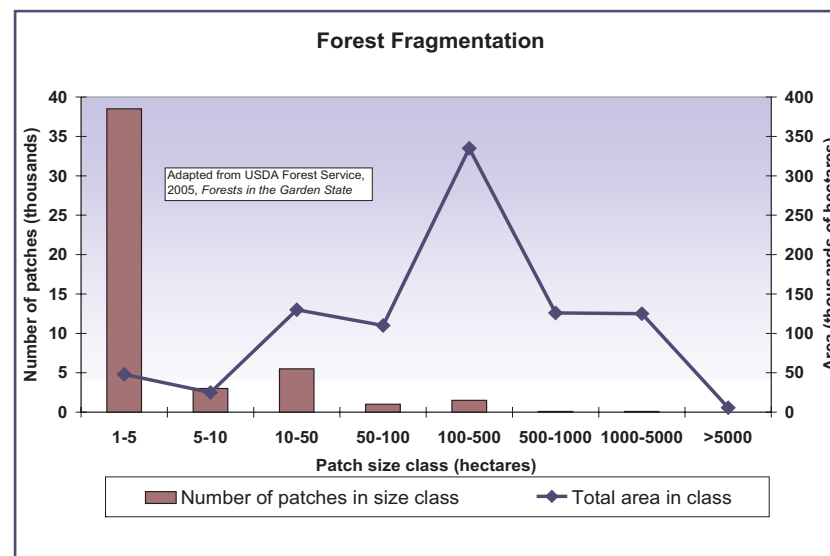
"Timberland Area by Stand-size Class" shows that since 1972, areas characterized by saplings (poletimber) and seedlings have declined, and areas of larger trees (saw timber) have increased.

Overall, the woody biomass of NJ forests has increased since 1987. Since then, the net growth of trees in the state's timberlands has averaged 58 million cubic feet per year, while removals have averaged 36 million cubic feet. This translates to an increase of 0.8 percent per year in the volume of wood on the state's timberland.<sup>9</sup>

However, there are concerns that, in general, forest regeneration has declined; in some regions there are virtually no young seedlings to be found.<sup>10</sup> At least some of the decline in regeneration can be traced to deer. For example, a project to restore acreages of the Atlantic white-cedar has found that only where deer are controlled is regeneration successful.<sup>11</sup>

Another reason for less regeneration is forest succession, where the thick canopy of mature trees limits establishment and growth of some species of seedlings.

Not only is development consuming forest areas, it also is breaking up existing contiguous forest areas into smaller tracts. This process is called fragmentation, and it degrades watersheds, reduces wildlife habitat, increases site disturbances and favors invasion by exotic plant species and predators such as feral housecats. Fragmentation is believed to be a contributing factor in the decline of some bird species and other wildlife (see the chapter on passerines, or perching birds, elsewhere in this Environmental Trends series). USDA Forest Service scientists are attempting to characterize the distribution and parcel size of forested tracts in New Jersey.<sup>12</sup> (See "Forest Fragmentation" below).



There are indications that New Jersey's forests are troubled by an increase in insects and disease.<sup>13</sup> Insects that are especially problematic include the Asian long-horned beetle, the gypsy moth, the orangestriped oakworm, the hemlock woolly adelgid, and the southern pine beetle. The Asian long-horned beetle, an invasive alien species, is currently the subject of an intensive eradication campaign that will include the destruction of more than 4,000

trees in northern sections of the state. Tree diseases that require careful monitoring include bacterial leaf scorch and sudden oak death.<sup>14</sup>

#### Wetlands and other prime wildlife habitat

Certain areas of the state are especially important in maintaining biodiversity. The DEP Division of Fish and Wildlife's Endangered and Nongame Species Program (ENSP) adopted a GIS approach to imperiled species protection called the Landscape Project. The project uses GIS to identify and delineate habitat critical to the long-term survival of New Jersey's wildlife.<sup>15</sup> Comparisons between the satellite imagery used to track changes in land use and land cover between 1995 and 2000, discussed above, and our Landscape Project maps reveal that prime wildlife habitat (habitat for listed endangered and threatened species, as well as priority wildlife species)<sup>16</sup> has been lost to development at an estimated rate of 13,900 acres per year. Included in the acres lost are an estimated 7,600 acres lost per year of documented habitat of threatened and endangered species.

New Jersey protects wetlands under the New Jersey Freshwater Wetlands Protection Act. This law also protects transition areas, or buffers, around freshwater wetlands. New Jersey also protects coastal wetlands under the Wetlands Act of 1970. Based on recent satellite data (See the chart "Rate of Land Use Change" above), the rate at which wetlands have been lost to development appears to have slowed since New Jersey's freshwater wetlands law became effective in 1988. However, the goal of no net loss of wetlands still is not being met. Further, it has been found that some wetlands mitigations, although apparently meeting the requirements of the law, have not resulted in wetlands that are likely to be fully functional over time.<sup>17</sup> Wetlands may be vulnerable to hydrological changes associated with nearby construction, such as drainage systems for roads or parking lots. A recent report found that more than 1000 acres of wetlands per year are within 50 feet of new development and more than 6000 acres of wetlands per year are within 300 feet of new development.<sup>18</sup>

#### Outlook and Implications

The state has taken a variety of actions to protect New Jersey from poorly planned land use changes, and to control secondary impacts of such changes, such as increased stormwater runoff and habitat destruction.

Actions recently taken include the following:

- ◆ New Stormwater Rules: Two sets of new stormwater rules were adopted in February 2004. The first set of rules are intended to address and reduce pollutants associated with existing stormwater runoff. The second set of regulations set forth the required components of regional and municipal stormwater management plans, and establish the stormwater management design and performance standards for new development.<sup>19</sup> These rules will reduce pollution from stormwater runoff, replenish vital groundwater supplies and minimize the adverse effects of new development by requiring 300-foot vegetated buffers along more than 6,000 miles of Category One waterways.
- ◆ Category One: The DEP continues to designate a special level of protection for a number of waterways in New Jersey. This protection, known as Category One (C1), targets waterbodies that provide drinking water, habitat for endangered and threatened species, and popular recreational and/or commercial species, such as trout or shellfish. Waterways can be designated C1 because of exceptional ecological significance, exceptional water supply significance, exceptional recreational significance, exceptional shellfish resource, or exceptional fisheries resource. The C1 designation provides additional protections to waterbodies that help prevent water-quality degradation and discourage development where it would impair or destroy natural resources and environmental quality.<sup>20</sup> Since 2003, C1 protection has been applied to nearly 600 miles of waterways and nine reservoirs, totaling 7,865 acres, from which 4 million people get some or all of their drinking water. Previously, the C1 designation was used only to protect healthy, trout-spawning streams.<sup>21</sup>
- ◆ Highlands Protection: On Aug. 10, 2004, the Highlands Water Protection and Planning Act (HWPPA) was signed into law. This historic legislation establishes protective environmental standards on a 1,250-square-mile area in northern New Jersey known as the Highlands region, which covers portions of seven counties and 88 municipalities, and provides drinking water for more than 5 million people. The Highlands contain exceptional natural resources such as contiguous forests, wetlands, pristine watersheds and plant and wildlife species habitats. It also encompasses sites of historic significance and provides abundant recreational opportunities for the public. The new law will help preserve New Jersey's dwindling open space by restricting

certain types of development. Since 1984, 65,000 acres of the Highlands region have been lost to development, and sprawl and the pace of development in the region has dramatically increased with the rate of loss of forested lands and wetlands more than doubling since 1995.<sup>22</sup>

- ◆ More Open Space Preservation, Parks, and Tree Plantings: A variety of initiatives within the DEP and the state are increasing the amount of open space preserved, expanding and improving the state park system, and restoring and expanding urban forests. (See separate chapters on within this Environmental Trends series on Open Space Preservation, State Parks and Forests, and Urban and Community Forests).
- ◆ Vernal Pools Protection: To curtail the loss of these special, ecologically significant wetland habitats, vernal pools must be identified, surveyed and mapped. Vernal pools then can be afforded protection under DEP's land use regulations as development proposals are screened. An ongoing project to identify potential vernal-pool locations is being conducted by CRSSA in collaboration with DEP,<sup>23</sup> which has been performing on-site inspections to identify and characterize vernal pools, and has been encouraging volunteers to assist in this process.<sup>24</sup>
- ◆ Additional Smart Growth Initiatives: Many of the actions listed above will ameliorate the effects of poorly planned growth and encourage growth that is more protective of the state's resources. A variety of these efforts are initiated and coordinated by the DEP and other state agencies, especially the Office of Smart Growth in the Department of Community Affairs.<sup>25</sup>

## References

<sup>1</sup> NJ Department of Environmental Protection (DEP), 2004, *New Jersey Comparative Risk Project*, NJDEP, Trenton, NJ, <http://www.state.nj.us/dep/dsr/njcrp/>. Also named as important stressors to the environment in the study were indoor air pollution, invasive species, and outdoor air pollution.

<sup>2</sup> U.S. Forest Service, 2004, [http://www.na.fs.fed.us/spfo/pubs/n\\_resource/wetlands/#Introduction](http://www.na.fs.fed.us/spfo/pubs/n_resource/wetlands/#Introduction)

<sup>3</sup> NJDEP, 2004, Natural Heritage Database, Division of Parks and Forestry, Office of Natural Lands Management, Trenton, NJ.

<sup>4</sup> New Jersey DEP, 2001, *NJ Environmental Indicators Technical Report*, 2<sup>nd</sup>

*Edition*, Land Use and Natural Resources Chapter, available under "historical documents" at <http://www.state.nj.us/dep/dsr/indicator-report/>

<sup>5</sup> See The DEP Geographical Information System web site, <http://www.state.nj.us/dep/gis/>. Analysis of DEP-sponsored high-resolution photographs of the entire state taken between 1986 and 1995 have yielded extensive information about types of land use and land cover and the changes affecting them. The DEP uses a computerized geographical information system (GIS) to superimpose "layers" of data and information, e.g. municipal boundaries, on the photographs. The DEP determines types of land use and land cover based on its analysis of photo imagery, and presents this information as a data layer. The DEP is currently analyzing the 2002 photo imagery and determining land use/land cover classifications. These classifications will be made available as new data layers in the GIS soon.

<sup>6</sup> State-of-the-art research in satellite and related new methods of monitoring changes in the land surface is carried out at the Grant F. Walton Center for Remote Sensing and Spatial Analysis at Rutgers University (CRSSA).

<sup>7</sup> For example, the USDA Forest Service's Northeastern Research Station Forest Inventory and Analysis Unit, in cooperation with the DEP's Division of Parks and Forestry, completed a fourth statewide inventory of New Jersey's forest resources in 1999. This inventory uses aerial photographs and in-person measurements taken at a sample of 433 plots to obtain detailed information on the condition of the state's forests, including health, species density, tree size, and other factors.

<sup>8</sup> USDA Forest Service, 2005, *Forests in the Garden State*, USDA Forest Service, Forest Inventory & analysis, 11 Campus Blvd., Suite 200, Newtown Square, PA. <http://www.fs.fed.us/ne/fia>.

<sup>9</sup> USDA Forest Service, 2005, *Forests in the Garden State*

<sup>10</sup> Lempicki, Edward, NJDEP Bureau of Forest Management, Trenton, personal communication, 12/16/04.

<sup>11</sup> Zimmermann, George, 1995, The Atlantic White-Cedar (*Chamaecyparis thyoides*) Regeneration Experiments: Years Three and Four (Final Reports). Trenton, NJ: New Jersey Department of Environmental Protection.

<sup>12</sup> USDA Forest Service, 2005, *Forests in the Garden State*

<sup>13</sup> Lempicki, Edward, 2004, personal communication.

<sup>14</sup> See [http://www.state.nj.us/dep/parksandforests/forest/njfs\\_forest\\_health.html](http://www.state.nj.us/dep/parksandforests/forest/njfs_forest_health.html).

<sup>15</sup> See <http://www.state.nj.us/dep/fgw/ensp/landscape/index.htm>.

<sup>16</sup> Niles, L. J., M. Valent, P. Winkler and P. Woerner. 2004. New Jersey's

Landscape Project, Version 2.0. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. Available at [http://www.njfishandwildlife.com/ensp/landscape/lp\\_report.pdf](http://www.njfishandwildlife.com/ensp/landscape/lp_report.pdf)

<sup>17</sup> Balzano, S., A. Ertman, L. Brancheau, and W. Smejkal. Creating indicators of wetland status (quantity and quality): freshwater wetland mitigation in New Jersey. March 2002. Final report to NJDEP, Marjorie Kaplan and David Fanz, Project Managers. Prepared by Amy S. Greene Environmental Consultants, Inc.

Available at <http://www.state.nj.us/dep/dsr/wetlands/>.

<sup>18</sup> Tulloch, David, and Richard Lathrop, 2004, Exploratory Evaluation of New Jersey Land Use Change in Relation to Spatial Proximity to Wetlands, final report to the NJ Center for Environmental Indicators and t, Rutgers University, New Brunswick, and to the NJDEP, Division of Science, Research & Technology, Michael Aucott, Project Mgr., Trenton, NJ.

<sup>19</sup> See <http://www.nj.gov/dep/stormwater/>

<sup>20</sup> See <http://www.state.nj.us/dep/cleanwater/c1.html>

<sup>21</sup> NJDEP, 2004, Commissioner's Update, November-December, 2004, available at <http://www.nj.gov/dep/commissioner/update/updatenovdec04.pdf>

<sup>22</sup> See <http://www.savethehighlands.org/>

<sup>23</sup> See <http://www.crssa.rutgers.edu/projects/biodiv/>.

<sup>24</sup> See <http://www.state.nj.us/dep/fgw/ensp/vrnpoolupdate03.htm>.

<sup>25</sup> See <http://www.nj.gov/dep/antisprawl/> and <http://www.nj.gov/dca/osg/>